Draft-Final

Site Investigation and Fill Area Definition Report

Parcels 78(6), 79(6), 80(6), 81(5), 175(5), 230(7), 227(7), 126(7), 229(7), 231(7), 233(7), and 82(7) Fort McClellan, Calhoun County, Alabama

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Prepared for:

U.S. Army Corps of Engineers, Mobile District
109 St. Joseph Street
Mobile, Alabama 36602

Prepared by:

IT Corporation
312 Directors Drive
Knoxville, Tennessee 37923

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Executive Summary

IT Corporation (IT) prepared this Site Investigation (SI) and Fill Area Definition Report (FADR) to document activities performed at Fort McClellan (FTMC), Calhoun County, Alabama. The report summarizes the results of investigations to determine the nature and extent of fill material and also identifies whether chemicals of concern are present in the environmental media. Additionally, the report provides site-specific data to support recommendations in the Engineering Evaluation/Cost Analysis for these landfills and fill areas. The Army has identified the following 10 landfill/fill areas, consisting of 12 parcels, at FTMC as sites of former disposal actions from a variety of mission-related activities.

Summary of Investigations. Based on data presented in the FADR, the extent of fill has been defined for each landfill and fill area as follows:

- ***Landfill No. 1, Parcel 78(6).*** This parcel was the subject of a remedial investigation (RI) by Science Applications International Corporation (SAIC); therefore, no additional SI activities were necessary. Fill area definition activities consisted of geophysical surveys, trenching, and fill material boring installation. Based on the results of the investigations, the fill material covers approximately 6.3 acres and the average depth of fill is estimated to extend to 11.5 feet below ground surface (bgs).

- ***Landfill No. 2, Parcel 79(6).*** This parcel was included in the SAIC RI. In addition, surface soil sampling was performed at the site by IT. Fill area definition activities consisted of geophysical surveys, trenching, and fill material boring installation. Based on the results of the investigations, the fill material covers approximately 5.6 acres and the average depth of fill is estimated to extend to 8 feet bgs.

- ***Landfill No. 3, Parcel 80(6).*** This parcel was included in the SAIC RI and supplemental remedial investigations are currently being performed to define the extent of groundwater contamination. Fill area definition activities consisted of trenching and fill material boring installation. Based on the results of the investigations, the fill material covers approximately 22.8 acres and the average depth of fill is estimated to extend to 17 feet bgs.

- ***Landfill No. 4, Parcel 81(5), and the Industrial Landfill, Parcel 175(5).*** These parcels constitute an active permitted landfill; therefore, no additional SI or fill area definition activities were performed. The fill material covers approximately 59.2 acres.

- ***Fill Area North of Landfill No. 2, Parcel 230(7).*** This parcel was the subject of an SI by IT. Fill area definition activities consisted of geophysical surveys, trenching, and fill material boring installation. Based on the results of the investigations, the fill material covers approximately 2.4 acres and the average depth of fill is estimated to extend to 15 feet bgs.

- ***Fill Area East of Reilly Airfield, Parcel 227(7), and the Former Post Garbage Dump, Parcel 126(7).*** These parcels were the subject of SIs by IT. Fill area definition activities consisted of geophysical surveys, trenching, and fill material boring installation. Based on the results of the investigations, the total fill material at both parcels covers approximately 6.5 acres. The average depth of fill at Parcel 227(7) is estimated to extend to 8 feet bgs; the average depth to fill at Parcel 126(7) is estimated to extend to 3 feet bgs.

- ***Fill Area Northwest of Reilly Airfield, Parcel 229(7).*** This parcel was the subject of an SI by IT. Fill area definition activities consisted of geophysical surveys, trenching, and fill material boring installation. Based on the results of the investigations, the fill material covers approximately 5.9 acres and the average depth of fill is estimated to extend to 8 feet bgs.

- ***Fill Area at Range 30, Parcel 231(7).*** This parcel was the subject of an SI by IT. Fill area definition activities consisted of trenching, and fill material boring installation. The fill material covers approximately 3.9 acres and consists of fill piles overlying the ground surface. The average thickness of fill is estimated at 4 feet.

- ***Fill Area West of Iron Mountain Road and Range 19, Parcel 233(7).*** This parcel was the subject of an SI by IT. Fill area definition activities consisted of geophysical surveys, trenching, and fill material boring installation. Based on the Environmental Baseline Survey, the fill material boundary covers approximately 1.1 acres. However based on SI and fill area definition activities, no appreciable fill was observed.

- ***Stump Dump, Parcel 82(7).*** This parcel was the subject of an SI by IT. Fill area definition activities consisted of fill material boring installation. The fill material covers approximately 10 acres and the average depth of fill is estimated to extend to 8 feet bgs.

1.0 Introduction

1.1 Project Description

IT Corporation (IT) prepared this Site Investigation (SI) and Fill Area Definition Report (FADR) to document SI and fill area definition activities performed at Fort McClellan (FTMC), Calhoun County, Alabama. In addition, the report provides site-specific data to support recommendations in the Engineering Evaluation/Cost Analysis (EE/CA) for these landfills and fill areas. The U.S. Army is conducting studies of the environmental impact of suspected contaminants at FTMC under the management of the U.S. Army Corps of Engineers (USACE)-Mobile District. The USACE contracted IT to conduct fill area definition activities in support of the EE/CA for the following fill areas:

- Landfill No. 1, Parcel 78(6)
- Landfill No. 2, Parcel 79(6)
- Landfill No. 3, Parcel 80(6)
- Landfill No. 4 and Industrial Landfill, Parcel 81(5) and 175(5)
- Fill Area North of Landfill No. 2, Parcel 230(7)
- Fill Area East of Reilly Airfield and Former Post Garbage Dump, Parcels 227(7) and 126(7)
- Fill Area Northwest of Reilly Airfield, Parcel 229(7)
- Fill Area at Range 30, Parcel 231(7)
- Fill Area West of Iron Mountain Road and Range 19, Parcel 233(7)
- Stump Dump, Parcel 82(7).

These fill areas are located on the Main Post of FTMC (Figures 1-1 and 1-2). Fill area definition activities were performed under Task Order CK09, Contract Number DACA21-96-D-0018 (USACE, 1999a) in accordance with the EE/CA Fill Area Definition Work Plan (IT, 2000a).

IT previously conducted SIs at the following fill areas:

- Fill Area North of Landfill No. 2, Parcel 230(7)
- Fill Area East of Reilly Airfield and Former Post Garbage Dump, Parcels 227(7) and 126(7)

- Fill Area Northwest of Reilly Airfield, Parcel 229(7)

- Fill Area at Range 30, Parcel 231(7)

- Fill Area West of Iron Mountain Road and Range 19, Parcel 233(7)

- Stump Dump, Parcel 82(7).

SIs were performed under Task Order CK05, Contract Number DACA21-96-D-0018, according to the site-specific field sampling plan (FSP) attachments (IT, 1998a, 1998b, 1998c, 1998d, 2000b) to the installation-wide sampling and analysis plan (SAP) (IT, 1998e) for FTMC. The FSPs were used in conjunction with the site-specific safety and health plan (SSHP) for the fill areas, the installation-wide work plan (WP) (IT, 1998f) and SAP. The site-specific hazard analyses are included in the SSHP.

IT has prepared this SI and FADR to document the results of the SI and fill area definition activities and to characterize the extent of waste fill at each fill area. Because field activities for the fill area definition were based on and directly followed the SI field work, a separate SI report was not prepared.

1.2 Scope of Work

The SI and fill area definition studies were initiated to identify chemicals of potential concern (COPCs), assess potential impacts to soils, groundwater, and other media, and determine the vertical and horizontal extent of the fill areas. The scope of work for activities associated with the SIs and the EE/CA fill area definition investigations included the following tasks:

- Development of the FSP attachments

- Development of the SSHP attachments

- Geophysical surveys to help identify extent of potential waste fill and support selecting locations for trenching and soil boring activities at six fill areas (Landfill No. 1, Landfill No. 2, Fill Area North of Landfill No. 2, Fill Area East of Reilly Airfield and Former Post Garbage Dump, Fill Area Northwest of Reilly Airfield, and Fill Area West of Iron Mountain Road and Range 19)

- Conduct surface and downhole unexploded ordinance (UXO) avoidance activities for all intrusive drilling and trenching activities to identify buried hazards at four fill areas (Fill Area North of Landfill No. 2, Fill Area at Range 30, Fill Area West of Iron Mountain Road and Range 19, and Stump Dump) in support of the SIs and fill area definition

- Installation of temporary and permanent groundwater monitoring wells at six fill areas (Fill Area North of Landfill No. 2, Fill Area East of Reilly Airfield and the Former Post Garbage Dump, Fill Area Northwest of Reilly Airfield, Fill Area at Range 30, Fill Area West of Iron Mountain Road and Range 19, and the Stump Dump) in support of the SIs

- Collection of groundwater, surface water, sediment, surface soil, depositional soil, subsurface soil, and seep water samples at six fill areas (Fill Area North of Landfill No. 2, Fill Area East of Reilly Airfield and the Former Post Garbage Dump, Fill Area Northwest of Reilly Airfield, Fill Area at Range 30, Fill Area West of Iron Road and Range 19, and the Stump Dump) in support of the SIs

- Analysis of samples for the parameters listed in Section 2.4

- Installation of soil borings to determine the vertical extent of 9 fill areas

- Collection of soil samples from the soil borings at 9 fill areas to provide data in characterizing the fill material to support the EE/CA

- Excavation of exploratory trenches to define fill area boundaries

1.3 Facility Description and Regional History

Fort McClellan is located in the foothills of the Appalachian Mountains of northeastern Alabama near the cities of Anniston and Weaver in Calhoun County. The post is approximately 60 miles northeast of Birmingham and 75 miles northwest of Auburn, Alabama, and 95 miles west of Atlanta, Georgia. Fort McClellan consists of two main areas of government-owned properties: Main Post and Pelham Range. A third area, designated Choccolocco Corridor, was previously leased from the State of Alabama; however, the lease was terminated in May 1998. The size of each property is presented below:

Main Post	18,929 acres
Pelham Range	22,245 acres
Choccolocco Corridor (formerly leased)	4,488 acres

The Main Post is bounded on the east by the Choccolocco Corridor, which connects the Main Post with the Talladega National Forest. Pelham Range is located approximately 5 miles west of the Main Post and adjoins the Anniston Army Depot on the southwest. Pelham Range is bordered on the east by U.S. Highway 431.

FTMC is under the jurisdiction of the U.S. Army Training and Doctrine Command (TRADOC). The installation housed three major organizations including the U.S. Army Military Police School, the U.S. Army Chemical School, and the Training Center (under the direction of the training brigade), in addition to other major support units and tenants.

The U.S. government purchased 18,929 acres of land near Anniston in 1917 for use as an artillery range and a training camp because of the outbreak of World War I. The site was named Camp McClellan in honor of Major General George B. McClellan, a former leader of the Union Army during the Civil War. Camp McClellan was used to train troops for World War I from 1917 until the armistice. It was then designated as a demobilization center. Between 1919 and 1929, Camp McClellan served as a training area for active army units and other civilian elements. Camp McClellan was redesignated as FTMC in 1929 and continued to serve as a training area.

In 1940, the government acquired an additional 22,245 acres west of FTMC. This tract of land was named Pelham Range. In 1941, the Alabama Legislature leased approximately 4,488 acres to the U.S. government to provide an access corridor from the Main Post to Talladega National Forest. This corridor provided access to additional woodlands for training.

The U.S. Army operated the Chemical Corps School at FTMC from 1951 until the school was deactivated in 1973. The school was then reactivated in 1979 and was closed at the time of base closure in 1999 (Environmental Science and Engineering, Inc. [ESE], 1998). The Chemical Corps School offered advance training in all phases of chemical, biological, and radiological warfare to students from all branches of military service.

Recent ongoing activities at FTMC can be divided into support activities, academic training, and practical training. Support activities include housing, feeding, and moving individuals during training. Academic training includes classroom, laboratory, and field instruction. Practical training includes weapons, artillery and explosives, vehicle operation and maintenance, and physical and tactical training activities. In September 1999, FTMC was closed under the Base Realignment and Closure Program.

1.4 Regional Setting

The regional setting of the Main Post is pertinent to the characterization of site-specific conditions at the fill areas and is presented below.

1.4.1 Regional Geology

Calhoun County includes parts of two physiographic provinces, the Piedmont Upland Province and the Valley and Ridge Province. The Piedmont Upland Province occupies the extreme eastern and southeastern portions of the county and is characterized by metamorphosed sedimentary rocks. The generally accepted range in age of these metamorphics is Cambrian to Devonian.

The majority of Calhoun County, including the Main Post of FTMC, lies within the Appalachian fold and thrust structural belt (Valley and Ridge Province) where southeastward-dipping thrust faults with associated minor folding are the predominant structural features. The fold and thrust belt consists of Paleozoic sedimentary rocks that have been asymmetrically folded and thrust-faulted with major structures and faults striking in a northeast-southwest direction. Northwestward transport of the Paleozoic rock sequence along the thrust faults has resulted in the imbricate stacking of large slabs of rock referred to as thrust sheets. Within an individual thrust sheet, smaller faults may splay off the larger thrust fault, resulting in imbricate stacking of rock units within an individual thrust sheet (Osborne and Szabo, 1984). Geologic contacts in this region generally strike parallel to the faults and repetition of lithologic units is common in vertical sequences. Geologic formations within the Valley and Ridge Province portion of Calhoun County have been mapped by Warman and Causey (1962), Osborne and Szabo (1984), and Moser and DeJarnette (1992), and vary in age from Lower Cambrian to Pennsylvanian.

The basal unit of the sedimentary sequence in Calhoun County is the Cambrian Chilhowee Group. The Chilhowee Group is comprised of the Cochran, Nichols, Wilson Ridge, and Weisner Formations (Osborne and Szabo, 1984), but in Calhoun County is either undifferentiated or divided into the Cochran and Nichols Formations and an upper undifferentiated Wilson Ridge and Weisner Formation. The Cochran is composed of poorly sorted arkosic sandstone and conglomerate with interbeds of greenish-gray siltstone and mudstone. Massive to laminated, greenish-gray and black mudstone makes up the Nichols Formation with thin interbeds of siltstone and very fine-grained sandstone (Szabo et al., 1988). These two formations are mapped only in the eastern part of the county.

The Wilson Ridge and Weisner Formations are undifferentiated in Calhoun County and consist of both coarse-grained and fine-grained clastics. The coarse-grained facies appear to dominate the unit and consist primarily of coarse-grained, vitreous quartzite, and friable, fine- to coarse-grained, orthoquartzitic sandstone, both of which locally contain conglomerate. The fine-grained facies consists of sandy and micaceous shale and silty, micaceous mudstone which are locally interbedded with the coarse clastic rocks. The abundance of orthoquartzitic sandstone and quartzite suggests that most of the Chilhowee Group bedrock in the vicinity of FTMC belongs to the Weisner Formation (Osborne and Szabo, 1984).

The Cambrian Shady Dolomite overlies the Weisner Formation northeast, east and southwest of the Main Post and consists of interlayered bluish-gray or pale yellowish-gray sandy dolomitic limestone and siliceous dolomite with coarsely crystalline porous chert (Osborne et al., 1989). A variegated shale and clayey silt have been included within the lower part of the Shady Dolomite (Cloud, 1966). Material similar to this lower shale unit was noted in core holes drilled by the Alabama Geologic Survey on FTMC (Osborne and Szabo, 1984). The character of the Shady Dolomite in the FTMC vicinity and the true assignment of the shale at this stratigraphic interval are still uncertain (Osborne 1999, personal communication).

The Rome Formation overlies the Shady Dolomite and locally occurs to the northwest and southeast of the Main Post as mapped by Warman and Causey (1962) and Osborne and Szabo (1984), and immediately to the west of Reilly Airfield (Osborne and Szabo, 1984). The Rome Formation consists of variegated thinly interbedded grayish-red-purple mudstone, shale, siltstone, and greenish-red and light gray sandstone, with locally occurring limestone and dolomite. The Conasauga Formation overlies the Rome Formation and occurs along anticlinal axes in the northeastern portion of Pelham Range (Warman and Causey, 1962), (Osborne and Szabo, 1984) and the northern portion of the Main Post (Osborne et al., 1997). The Conasauga Formation is composed of dark-gray, finely to coarsely crystalline medium- to thick-bedded dolomite with minor shale and chert (Osborne et al., 1989).

Overlying the Conasauga Formation is the Knox Group, which is composed of the Copper Ridge and Chepultepec dolomites of Cambro-Ordovician age. The Knox Group is undifferentiated in Calhoun County and consists of light medium gray, fine to medium crystalline, variably bedded to laminated, siliceous dolomite and dolomitic limestone that weathers to a chert residuum (Osborne and Szabo, 1984). The Knox Group underlies a large portion of the Pelham Range area.

The Ordovician Newala and Little Oak Limestones overlie the Knox Group. The Newala Limestone consists of light to dark gray, micritic, thick-bedded limestone with minor dolomite. The Little Oak Limestone is comprised of dark gray, medium- to thick-bedded, fossiliferous, argillaceous to silty limestone with chert nodules. These limestone units are mapped together as undifferentiated at FTMC and other parts of Calhoun County. The Athens Shale overlies the Ordovician limestone units. The Athens Shale consists of dark-gray to black shale and graptolitic shale with localized interbedded dark gray limestone (Osborne et al., 1989). These units occur within an eroded "window" in the uppermost structural thrust sheet at FTMC and underlie much of the developed area of the Main Post.

Other Ordovician-aged bedrock units mapped in Calhoun County include the Greensport Formation, Colvin Mountain Sandstone, and Sequatchie Formation. These units consist of various siltstones, sandstones, shales, dolomites and limestones, and are mapped as one, undifferentiated unit in some areas of Calhoun County. The only Silurian-age sedimentary formation mapped in Calhoun County is the Red Mountain Formation. This unit consists of interbedded red sandstone, siltstone, and shale with greenish-gray to red silty and sandy limestone.

The Devonian Frog Mountain Sandstone consists of sandstone and quartzitic sandstone with shale interbeds, dolomudstone, and glauconitic limestone (Szabo et al., 1988). This unit locally occurs in the western portion of Pelham Range.

The Mississippian Fort Payne Chert and the Maury Formation overlie the Frog Mountain Sandstone and are composed of dark- to light-gray limestone with abundant chert nodules and greenish-gray to grayish-red phosphatic shale with increasing amounts of calcareous chert toward the upper portion of the formation (Osborne and Szabo, 1984). These units occur in the northwestern portion of Pelham Range. Overlying the Fort Payne Chert is the Floyd Shale, also of Mississippian Age, which consists of thin-bedded, fissile brown to black shale with thin intercalated limestone layers and interbedded sandstone. Osborne and Szabo (1984) reassigned the Floyd Shale, which was mapped by Warman and Causey (1962) on the Main Post of Fort McClellan, to the Ordovician Athens Shale on the basis of fossil data.

The Jacksonville Thrust Fault is the most significant structural geologic feature in the vicinity of FTMC, both for its role in determining the stratigraphic relationships in the area and for its contribution to regional water supplies. The trace of the fault extends northeastward for approximately 39 miles between Bynum, Alabama and Piedmont, Alabama. The fault is interpreted as a major splay of the Pell City fault (Osborne and Szabo, 1984). The Ordovician sequence comprising the Eden thrust sheet is exposed at FTMC through an eroded "window" or "fenster" in the overlying thrust sheet. Rocks within the window display complex folding with the folds being overturned, and tight to isoclinal. The carbonates and shales locally exhibit well-developed cleavage (Osborne and Szabo, 1984). The FTMC window is framed on the northwest by the Rome Formation, north by the Conasauga Formation, northeast, east, and southwest by the Shady Dolomite, and southeast and southwest by the Chilhowee Group (Osborne et al., 1997). A geologic map of the Main Post area of FTMC is presented in Figure 1-3.

1.4.2 Regional Hydrogeology

The hydrogeology of Calhoun County has been investigated by the Geologic Survey of Alabama (GSA) (Moser and DeJarnette, 1992) and the USGS in cooperation with the GSA (Warman and Causey, 1962) and Alabama Department of Environmental Management (ADEM) (Planert and Pritchette 1989). Groundwater in the vicinity of FTMC occurs in residuum derived from bedrock decomposition; within fractured bedrock; along fault zones; and from the development of karst frameworks. Groundwater flow may be estimated to be toward major surface water features. However, because of the impacts of differential weathering, variable fracturing, and the potential for conduit flow development, the use of surface topography as an indicator for groundwater flow direction must be used with caution in the area. Groundwater flow direction in areas with well-developed residuum horizons may subtly reflect the surface topography, but it also may exhibit the influence of pre-existing structural fabrics or the presence of perched water horizons on unweathered ledges or impermeable clay lenses.

Precipitation in the form of rainfall averages about 54 inches annually in Anniston, Alabama with infiltration rates annually exceeding evapotranspiration rates, (approximately 43 inches per year). However, from January 1998 through December 1989, rainfall totals were approximately 15 inches below average for the period (National Oceanic and Atmospheric Administration [NOAA], 1999). Precipitation and subsequent infiltration provide recharge to the groundwater flow system in the region. The main recharge areas for the aquifers in Calhoun County are located in the valleys. The ridges generally consist of sandstone, quartzite, and slate which are resistant to weathering, relatively unaffected by faulting, and therefore, relatively impermeable. The ridges have steep slopes and thin to no soil cover, which enhances runoff to the edges of the valleys (Planert and Pritchette 1989).

The thrust fault zones typical of the county form large storage reservoirs for groundwater. Points of discharge occur as springs, effluent streams, and lakes. Coldwater Spring is the largest spring in the State of Alabama with a discharge of approximately 32 million gallons per day. This spring is the main source of water for the Anniston Water Department from which FTMC buys its water. The spring is located approximately 5 miles southwest of Anniston and discharges from the brecciated zone of the Jacksonville Fault (Warman and Causey, 1962).

Shallow groundwater on FTMC occurs principally in the residuum developed from Cambrian sedimentary and carbonate bedrock units of the Weisner Formation, Shady Dolomite and locally in lower Ordovician carbonates. The residuum may yield adequate groundwater for domestic and livestock needs but may go dry during prolonged dry weather. Groundwater within the residuum serves as a recharge reservoir for the underlying bedrock aquifers. Bedrock permeability is locally enhanced by fracture zones associated with thrust faults and by the development of solution (karst) features.

Two major aquifers were identified by Planert and Pritchette (1989), the Knox-Shady and Tuscumbia-Fort Payne aquifers. The continuity of the aquifers has been disrupted by the complex geologic structure of the region, such that each major aquifer occurs repeatedly in different areas. The Knox-Shady aquifer group occurs over most of Calhoun County and is the main source of groundwater in the county. It consists of the Cambrian and Ordovician aged quartzite and carbonates. The Conasauga Dolomite is the most utilized unit of the Knox-Shady aquifer with twice as many wells drilled as any other unit (Moser and DeJarnette, 1992). A potentiometric surface map for the general vicinity of the fill areas is presented in Figure 1-4.

1.4.3 Regional Surface Hydrology

The major surface water features at the Main Post of FTMC include Remount Creek, Cane Creek, and Cave Creek. These waterways flow in a general northwest to westerly direction towards the Coosa River on the western boundary of Calhoun County. Floodplain data of the main post of FTMC is illustrated in Figure 1-5.

2.0 Field Activities

This section describes the field methods and procedures used by IT during the SI and fill area definition activities.

2.1 Clearances

As described in Section 1.2, four fill areas (Fill Area North of Landfill No. 2, Fill Area at Range 30, Fill Area West of Iron Mountain Road and Range 19, and Stump Dump) fall within the "Possible Explosive Ordnance Impact Area" shown on Plate 10 of the FTMC Archive Search Report, Maps (USACE, 1999b) or have requirements for UXO avoidance activities. Therefore, IT conducted UXO avoidance activities, including surface sweeps and downhole surveys of soil borings and trenches. The surface sweeps and downhole surveys were conducted to identify anomalies for the purposes of UXO avoidance.

2.1.1 Surface UXO Surveys

A UXO sweep was conducted over areas included in the sampling and surveying activities to identify potential UXO on or near the surface that may present a hazard to on-site workers during field activities. Low-sensitivity magnetometers were used to locate surface and shallow-buried metal objects. UXO located on the surface was identified and conspicuously marked for avoidance. Subsurface metallic anomalies in UXO suspected areas were not disturbed, and were marked for easy avoidance. UXO personnel requirements, procedures, and detailed descriptions of the geophysical equipment used are provided in Chapter 4.0 and Appendices D and E of the approved SAP (IT, 1998e).

2.1.2 Downhole Boring and Trench UXO Surveys

During the soil boring and downhole sampling activities, downhole UXO surveys were performed to determine if buried metallic objects were present. UXO monitoring, as described in Chapter 4.0 of the SAP (IT, 1998e), continued until undisturbed soils were encountered or the borehole or trench was advanced to 12 feet below ground surface (bgs).

2.1.3 Utility Clearances

Utility clearance was performed at all locations where soil borings were advanced, using the procedure outlined in Section 4.2.6 of the SAP (IT, 1998e). For the four sites that fall within the "Possible Explosive Ordnance Impact Area" shown on Plate 10 of the FTMC Archive Search Report, Maps (USACE, 1999b), UXO avoidance surveys were completed before utility clearance activities were done.

The site manager marked the proposed locations with stakes, coordinated with FTMC personnel to clear the proposed locations for utilities, and obtained digging permits prior to starting fieldwork. Once the locations were approved (for both UXO and utility avoidance) for intrusive sampling, the stakes were labeled as cleared.

2.2 Geophysical Surveys

As specified in the Site-Specific SI Work Plans, (IT, 1998a, 1998b, 1998c, 1998d) and the EE/CA Fill Area Definition Work Plan (IT, 2000a), IT conducted subsurface geophysical surveys at:

- Landfill No. 1, Parcel 78(6)
- Landfill No. 2, Parcel 79(6)
- Fill Area North of Landfill No. 2, Parcel 230(7)
- Fill Area East of Reilly Airfield and Former Post Garbage Dump, Parcels 227(7) and 126(7)
- Fill Area Northwest of Reilly Airfield, Parcel 229(7)
- Fill Area West of Iron Mountain Road and Range 19, Parcel 233(7).

Appendix A of this technical memorandum provides a detailed discussion of the geophysical methods and equipment utilized during the geophysical investigations. The results of the geophysical surveys were used in conjunction with geophysical data from previous reports (SAIC 1993, 1995, and 2000) and trenching data to help define the horizontal limits of the buried fill areas. The geophysics data also was used to target the locations of exploratory trenches and soil borings. The geophysical methods used included magnetics and frequency-domain electromagnetic (EM) induction.

2.2.1 Instrumentation and Methodology

The magnetic surveys were conducted using a Geometrics G-858G magnetic gradiometer (for collecting survey data) and a Geometrics G-856AX magnetometer or equivalent (for collecting base station data). Frequency-domain EM surveys were conducted using a Geonics EM31 terrain conductivity meter coupled to an Omnidata DL720 digital data logger. A Metrotech 9860-BRL EM utility locator (or equivalent) was used at select EM31 anomaly locations along the reconnaissance survey lines to help differentiate between anomalies caused by buried metal objects and anomalies caused by subsurface utilities trending through the sites.

Geophysical survey procedures used to conduct the investigation, including survey control, equipment calibration, field base station and data validation, data processing and interpretation, and file tracking procedures, were in accordance with the methods and procedures outlined in Chapter 4.0 of the SAP (IT, 1998e). The geophysical survey procedures included the following IT standard operating procedures for geophysical investigations:

- ITGP-001: Surface Magnetic Surveys
- ITGP-002: Surface Frequency-Domain Electromagnetic Surveys
- ITGP-005: Global Positioning System Surveys
- ITGP-010: Total Station Land Surveys
- ITGP-012: Geophysical Data Management.

The following tasks were performed prior to conducting the surveys:

- Reviewed existing site surface and subsurface information (e.g., aerial photographs, utility maps, boring logs, etc.)

- Evaluated the potential influence of cultural features (e.g., overhead and subsurface utilities, fences, buildings, etc.)

- Conducted a visual inspection of the sites to verify the likely location of the landfill areas

- Reviewed reconnaissance survey information from SAIC reports.

After reviewing the available information and visually inspecting each site, geophysical survey lines were established in the field.

2.2.1.1 Site Preparation and Survey Control

In areas of light to moderate tree canopy, reconnaissance geophysical survey lines were cleared of brush and a global positioning system (GPS) was used at the time of geophysical data acquisition to provide positional control. In areas of thick tree canopy, standard reconnaissance geophysical survey lines were established by clearing brush and marking stations. For the standard reconnaissance survey lines, the geophysics crew established the preliminary survey line stakes and/or surveyor's flagging to be used as a reference by the brush clearing crew. Survey lanes were cleared to a width of approximately 3 feet through the brush. Following brush removal, the geophysics crew established control points along the survey lines with surveyor's paint and/or plastic pin flags.

Where grid-based surveys were conducted a base grid was established throughout the site using either a GPS or total station system. Using the base grid as a reference, the geophysics crew marked control points throughout the site using surveyor's paint and/or plastic pinflags. To the extent possible, the grid was oriented in the north to south direction.

After the survey lines were complete and control points were marked, all surface objects that could potentially affect the geophysical data (e.g., metal objects, overhead utilities, reinforced concrete) were hand-sketched on a site map. The site map was used to document the locations of the survey lines. Surface features were correlated with anomalies to correctly locate and interpret anomalies caused by surface features. Where a GPS was used for geophysical survey positional control, site attribute mapping also was conducted with the GPS.

Where conventional geophysical survey data were acquired along established survey lines, land surveying was performed using a GPS and/or total station system to provide survey control of the geophysical lines and interpreted locations of landfill debris. The first and last station of each survey line was surveyed. Land survey data was referenced to the U.S. State Plane Coordinate System, Alabama East Zone (North American Datum [NAD], 1983).

2.2.1.2 Data Processing and Reporting

Geophysical data processing was completed in the field as the survey progressed. Geophysical anomalies were field-checked to verify their source as surface culture, pipelines, utilities or subsurface objects/debris. Source materials responsible for the observed geophysical anomalies were documented on the data profiles and contour maps.

The site-specific geophysics reports in Appendix A include a detailed discussion of the technical methods and field procedures used to conduct the surveys (instrument calibration, data quality assurance [QA], and survey control procedures), data processing, and the interpreted results of the investigation. The reports also include all reconnaissance geophysical profile data, select color-enhanced contour maps of EM and magnetic data, and a geophysical interpretation map of the site. The geophysical maps presented in the report are referenced to NAD, 1983, and indicate cultural features information (e.g., roads, buildings, power lines, and fences).

2.2.2 Aerial Coverage

Data acquisition parameters and anomaly verification work were conducted as follows:

- G-858G magnetic gradiometer data were collected at 0.5-second intervals (approximate 2.0- to 2.5-foot intervals) along the survey lines.

- EM31 survey data were collected at 5-foot intervals along the survey lines.

- A Metrotech 9860-BRL EM utility locator or equivalent was used at select EM31 anomaly locations along the reconnaissance survey lines to help differentiate between anomalies caused by buried metal objects and anomalies caused by subsurface utilities trending through the site.

2.3 Sample Collection Techniques

The environmental sampling performed during the SI and EE/CA fill area definition included the collection of surface soil samples, subsurface soil samples, surface water samples, sediment samples, seep water samples, groundwater samples, and depositional soil samples for chemical analysis. The placement of sample locations was determined by the site manager based on site physical characteristics noted during a site walk, and review of historical documents pertaining to activities conducted at the site. Sample documentation and chain-of-custody were completed as specified in Section 4.13 of the SAP. Sample containers, sample volumes, preservatives, and holding times for the analyses required in this SFSP are listed in Section 5.0, Table 5-1, of the SAP. Samples were submitted for laboratory analyses of parameters listed in Section 2.4. Sample collection logs and chain-of-custody records are included in Appendix B.

2.3.1 Surface Soil

Surface soil samples were collected from the upper 1 foot of soil by either direct-push technology or with a 3-inch diameter stainless-steel hand auger using the methodology specified in Section 4.9 of the SAP (IT, 1998e). Surface soil samples were collected by first removing surface debris, such as rocks and vegetation, from the immediate sample area. The soil was collected with the sampling device and screened using a photoionization detector (PID) in accordance with Section 4.7.1.1 of the SAP (IT, 1998e). Samples for volatile organic compound (VOC) analyses were collected directly from the sampler using three EnCore® samplers. The remaining portion of the sample was transferred to a clean stainless-steel bowl, homogenized, and placed in the appropriate sample containers. Sample collection logs are included in Appendix B. Samples were analyzed for the parameters listed in Section 2.4. Soil sampling locations were determined in the field by the on-site geologist based on the results of the sampling rationale, presence of surface structures, site topography, and buried utilities.

2.3.2 Subsurface Soil

Subsurface soil samples were collected from soil borings at a depth greater than 1-foot bgs in the unsaturated zone. The soil borings were advanced and soil samples collected using the direct-push sampling or hollow-stem-auger procedures specified in Section 4.9.1.1 of the SAP (IT, 1998e). Sample collection logs are included in Appendix B. The samples were analyzed for the parameters and methods outlined in Section 2.4.

Soil samples were collected continuously to 12 feet bgs or until direct-push or split-spoon sampler refusal was encountered. Subsurface soil samples were field screened using a PID in accordance with Section 4.7.1.1 of the SAP (IT, 1998e) to measure for volatile organic vapors. The sample showing the highest reading was selected and sent to the laboratory for analysis; however, at those locations where PID readings were not greater than background, the deepest sample interval above groundwater was submitted for analyses. Samples to be analyzed for VOCs were collected directly from the sampler with three EnCore® samplers. The remaining portion of the sample was transferred to a clean stainless-steel bowl, homogenized, and placed in the appropriate sample containers. The on-site geologist logging each borehole constructed a detailed lithological log. The lithological log for each borehole is included in Appendix C.

Soil boring locations were determined in the field by the on-site geologist based on the results of the geophysical survey, sampling rationale, presence of surface structures, site topography, and buried utilities. IT contracted TEG, Inc., a direct-push technology subcontractor, and Miller Drilling, Inc., a hollow-stem auger rig subcontractor, to assist in the collection of subsurface soil samples.

At the completion of subsurface soil sampling, boreholes were abandoned with hydrated bentonite chips following borehole abandonment procedures summarized in Appendix B of the SAP (IT, 1998e).

2.3.3 Groundwater

Groundwater samples were collected following methodology outlined in Section 4.7 of the SAP (IT, 1998e). Groundwater was sampled after purging a minimum three well volumes and after field parameters including temperature, pH, specific conductivity, oxidation reduction (redox) potential, and turbidity had stabilized. Purging and sampling were performed with a Fultz® positive gear displacement pump equipped with Teflon™ tubing. Field parameters were measured using either a Hydrolab® water quality unit or a Horiba® U-10 water quality unit. Field parameter readings are presented in each section where groundwater samples were collected. Sample collection logs are included in Appendix B. Samples were analyzed for the parameters listed in Section 2.4.

2.3.4 Surface Water

Surface water samples were collected in accordance with the procedures specified in Section 4.9.1.3 of the SAP (IT, 1998e). Surface water samples were collected by dipping a clean stainless-steel pitcher in the water and pouring the water into the appropriate sample containers. Surface water samples were collected after field parameters including temperature, pH, specific conductivity, redox potential, and turbidity had been measured using a Hydrolab® water quality unit. Samples were analyzed for the parameters listed in section 2.4. The exact sampling locations were determined in the field based on drainage pathways and actual field observations. Field parameter readings are presented in each section where surface water samples were collected.

2.3.5 Sediment

Sediment samples were collected with a stainless-steel trowel in accordance with the procedures specified in Section 4.9.1.2 of the SAP (IT, 1998e). Samples to be analyzed for VOCs were collected directly from the trowel with three EnCore® samples. The remaining portion of the sample was transferred to a clean stainless-steel bowl, homogenized, and placed in the appropriate sample containers. Sample collection logs are included in Appendix B. The sediment samples were analyzed for the parameters listed in Section 2.4. The sample locations were determined in the field, based on drainage pathways and actual field observations.

2.3.6 Depositional Soil

Depositional soil samples were collected from the upper 1-foot of soil with a stainless-steel trowel using the methodology specified in Section 4.9 of the SAP (IT, 1998e). Surface and depositional soil samples were collected by first removing surface debris, such as rocks and vegetation, from the immediate sample area. The soil was collected with the sampling device and screened with a PID in accordance with Section 4.7.1.1 of the SAP (IT, 1998e). Samples for VOC analyses were collected directly from the sampler with three EnCore® samplers. The remaining portion of the sample was transferred to a clean stainless-steel bowl, homogenized, and placed in the appropriate sample containers. Samples were analyzed for the parameters listed in Section 2.4. Sample collection logs are included in Appendix B.

2.3.7 Seep Water

Seep water samples were collected in accordance with the procedures specified in Section 4.9.1.3 of the SAP. Samples were collected using a stainless steel pitcher. The seep water flowed into the pitcher until a sufficient quantity was collected for the sample containers. The samples were analyzed for the parameters listed in Section 2.4. The sample collection logs are included in Appendix B.

2.4 Analytical Program

Samples collected during the SI and fill area definition activities were analyzed for suites of chemicals and elements based on the potential site-specific chemicals historically at the site and EPA, ADEM, FTMC, and USACE requirements. Except where qualified in the text, target analyses for samples collected included the following:

- Target Compound List (TCL) VOCs - Method 5035/8260B
- TCL Semivolatile Organic Compounds (SVOC) - Method 8270C
- Target Analyte List Metals - Method 6010B/7000
- Polychlorinated Biphenyls (PCB) - Method 8082
- Chlorinated Pesticides - Method 8081A
- Organophosphorus Pesticides - Method 8141A
- Chlorinated Herbicides - Method 8151A
- Nitroaromatic and Nitramine Explosives – Method 8330.

The samples were analyzed using EPA SW-846 methods, including Update III Methods where applicable, as presented in Table 6-1 in Appendix B of the SAP (IT, 1998e). Data were reported and evaluated in accordance with Corps of Engineers South Atlantic Savannah Level B criteria (USACE, 1994) and the stipulated requirements for the generation of definitive data (Section 3.1.2 of Appendix B of the SAP [IT, 1998e]). Chemical data were reported via hard copy data packages by the laboratory using Contract Laboratory Program-like forms. These packages were validated in accordance with EPA National Functional Guidelines by Level III criteria. A summary of validated data is included in Appendix D. Data validation summary reports are included in Appendix E. A complete (100 percent) Level III data validation effort was performed on the reported analytical data. The data validation summary reports were prepared to discuss the results of the validation. Selected results were rejected or otherwise qualified based on the implementation of accepted data validation procedures and practices during the validation effort. These qualified parameters are highlighted in the report. The validation-assigned qualifiers were added to the FTMC ITEMS™ database for tracking and reporting.

Validated analytical data collected during the SI and fill area definition investigation were compared to human health site-specific screening levels (SSSLs), ecological screening values (ESVs), and background screening values for FTMC. The SSSLs and ESVs were developed by IT as part of the human health and ecological risk evaluations associated with site investigations being performed under the BRAC environmental restoration program at FTMC. The SSSLs, ESVs, and polycyclic aromatic hydrocarbon (PAH) background screening values are presented in *the Final Human Health and Ecological Screening Values and PAH Background Summary Report* (IT, 2000c). The PAH background screening values were developed by IT at the direction of the BRAC Cleanup Team (BCT) to address the occurrence of PAH compounds in the surface soils as a result of anthropogenic activities at FTMC. Background metals screening values are presented in the *Final Background Metals Survey Report, Fort McClellan, Alabama* (Science Applications International Corporation [SAIC], 1998).

Metal concentrations exceeding the SSSLs and ESVs were subsequently compared to metals background screening values (background concentrations) (SAIC, 1998) to determine if the metals concentrations are within natural background concentrations. Summary statistics for background metals samples collected at FTMC (SAIC, 1998) are included in Appendix F. The effect of turbidity on metal concentrations in groundwater was evaluated and is discussed in Appendix G.

Six compounds were quantified by both SW-846 Method 8260B (as VOC) and Method 8270C (as SVOC), including 1,2,4-trichlorobenzene, 1,4-dichlorobenzene, 1,3-dichlorobenzene, 1,2-dichlorobenzene, hexachlorobutadiene, and naphthalene. Method 8260B yields a reporting limit (RL) of 0.005 milligrams per kilogram (mg/kg), while Method 8270C has a RL of 0.330 mg/kg, which is typical for a soil matrix sample. Because of the direct nature of the Method 8260B analysis and its resulting lower RL, this method should be considered superior to Method 8270C when quantifying low levels (0.005 to 0.330 mg/kg) of these compounds. Method 8270C and its associated methylene chloride extraction step is superior when dealing with samples that contain higher concentrations (greater than 0.330 mg/kg) of these compounds. Therefore, all data were considered and none were categorically excluded. Concentrations of constituents detected by both Methods 8260B and 8270C will be reported as both an SVOC and as a VOC. Concentrations detected by both methods may differ slightly because of the difference in procedures in which the methods are run in the laboratory. Data validation qualifiers were helpful in evaluating the usability of data, especially if calibration, blank contamination, precision, or accuracy indicator anomalies were encountered. The validation qualifiers and concentrations reported (e.g., whether concentrations were less than or greater than 0.330 mg/kg) were used to determine which analytical method was likely to return the more accurate result.

All data presented in this report, except where qualified, meet the principle data quality objectives of the EE/CA Fill Area Definition Work Plan.

2.5 Sample Preservation, Packaging, and Shipping

The field samples were collected, documented, handled, analyzed, and reported in a manner consistent with the SI and EECA Fill Area Definition work plans; the FTMC SAP and QAP; and standard, accepted methods and procedures. Sample collection logs pertaining to the collection of these samples were reviewed and organized for this report and are included in Appendix B.

Sample preservation, packaging, and shipping followed requirements specified in Section 4.13.2 of the SAP (IT, 1998e). Sample containers, sample volumes, preservatives, and holding times for the analyses required in this report are listed in Section 5.0, Table 5-1, of Appendix B of the SAP (IT, 1998e). Sample documentation and chain of custody were completed as specified in Section 4.13 of the SAP (IT, 1998e).

Completed analysis request and chain of custody records were secured and included with each shipment of sample coolers to Quanterra Environmental Services in Knoxville, Tennessee. Split samples were shipped to USACE South Atlantic Division Laboratory in Marietta, Georgia.

2.6 Monitoring Well Installation

2.6.1 Temporary Monitoring Well Installation

The temporary well locations were determined in the field by the on-site geologist based on the results of the geophysical survey, sampling rationale, presence of surface structures, site topography, and buried utilities. IT contracted Miller Drilling, Inc. to install the temporary wells. Drilling equipment included a CME 550 all terrain vehicle (ATV) using a 4-inch hollow-stem-auger. Temporary wells were constructed of 2-inch (inside diameter), 0.01-inch slotted Schedule 40 polyvinyl chloride (PVC) casing. The wells were installed following procedures outlined in Appendix C of the SAP (IT, 1998e). The lithologic log for each borehole is included in Appendix C.

2.6.2 Permanent Monitoring Well Installation

Permanent monitoring wells were installed at two fill areas (Fill Area West of Iron Mountain Road and Range 19 and Stump Dump). The monitoring well locations were determined in the field by the on-site geologist based on the results of the geophysical survey and sampling rationale, presence of surface structures, site topography, and buried utilities. IT contracted Miller Drilling, Inc. to install the monitoring wells. Wells at the Fill Area West of Iron Mountain Road and Range 19 were constructed of 2-inch (inside diameter), 0.01-inch slotted Schedule 40 PVC screen and casing. Wells at the stump dump, Parcel 82(7), were constructed of 4-inch (inside diameter) 0.01-inch slotted Schedule 80 PVC screen and casing. The casing was permanently sealed using hydrated bentonite pellets and a cement-bentonite grout. The wells were installed following procedures outlined in Appendix C of the SAP (IT, 1998e). The lithologic log for each borehole is included in Appendix C of this document.

2.6.3 Water Level Measurements

Depth to groundwater was measured in temporary and permanent groundwater monitoring wells with an electronic water level meter. The meter probe and cable were cleaned between use at each well location following decontamination methodology presented in Section 4.10 of the SAP (IT, 1998e). Measurements were referenced to the top of the PVC stickup. A summary of groundwater level measurements is presented in Appendix H. Groundwater elevations are shown on Figure 1-4.

2.7 Fill Material Borings

Fill material borings were conducted to determine the vertical extent of the fill material, characterize the fill material, and to collect a sample of fill material for chemical analysis. The fill material boring locations were determined in the field by the on-site geologist based on sampling rationale, previous fill area characterization, presence or absence of surface structures, and buried and overhead utilities. IT contracted Miller Drilling, Inc., to assist in subsurface fill material collection using hollow-stem-auger methods. In some cases, TEG was contracted to advance borings and sample fill material using direct-push methods. Sample documentation and chain-of-custody were recorded and are included in Appendix B.

2.8 Trenching

Trench locations were determined in the field by the on-site geologist based primarily on geophysics and sampling rationale, as well as site topography, presence or absence of surface structures, and buried and overhead utilities. Prior to trenching activities, trees and brush were cleared to allow trenching crews access to trench locations. Trenching activities were performed in Level C personal protective equipment (PPE). Trenches were excavated using a Caterpillar 320 Trackhoe or a Komatsu PLC250 remote controlled (UXO sites only) excavator to remove soil in the designated trench locations. Soil and fill material were stockpiled on the ground adjacent to the trench to allow field personnel access for inspection of the fill material. The on-site geologist recorded the soil lithology and fill material observed in the trenches. Upon completion of the inspection, the trenches were backfilled with the excavated material and compacted with the trackhoe bucket. Trench locations are shown in each site's corresponding site detail map presented in sections 3 through 12. Trench logs are included in Appendix I.

Trenching activities were conducted around the perimeter of the Fill Areas. The purpose of the perimeter trenching activities was to determine the horizontal extent (outer boundaries) of each Fill Area. The trenches along the perimeter were excavated perpendicular to the suspected fill material perimeter to confirm the horizontal extent of the waste fill material. Trenches were excavated using a track-mounted excavator with an approximately 3-foot-wide bucket.

Perimeter trenches were started in the location of where available information suggested the outside boundaries of the fill material exist. Whenever the trench excavation began in native soil, the trench excavation was extended toward the center of the Fill Area until the interface of the native soil and fill material was encountered. Likewise, whenever the trench excavation began in fill material, the trench excavation was extended outward from the fill area until the interface of the fill material and native soil was encountered.

In addition, trenching was conducted within each landfill to define anomalies located by geophysical surveys and to observe the waste fill material. There were 67 trenches proposed for nine of the fill areas. The number and locations of actual trenches for each fill area are presented in each site's field investigation section of this report.

Landfill No. 4 has been closed with a low-permeability, engineered cover and the Stump Dump was covered with soil and has engineered features such as terraced decks and engineered slopes. The Industrial Landfill is currently in operation. Hence, the lateral extent of fill at these parcels is known and trenches were not excavated at any of these areas.

Personnel did not enter trenches, and therefore, the trenches were excavated without sidewall shoring. After inspection and logging, the trenches were backfilled with the material removed from the trench during the excavation activities. Decontamination of the excavator between trenches was not required. However, when moving the excavator to another fill area, loose waste fill material on the excavator was brushed or scraped off to avoid tracking the material outside the fill areas.

The final trench locations were determined in the field by the on-site geologist, based on observed field conditions, UXO clearance results (three fill areas), and utility clearance results. Some fill area trench locations were relocated from the proposed locations after information gathered from the initial trenching activity. Trenching activities and results are further discussed in the corresponding site-specific sections of this technical memorandum.

2.9 Surveying of Sample, Boring, and Trench Locations

Sample locations, boring locations, and trench locations were surveyed using GPS survey techniques described in Section 4.3 of the SAP (IT, 1998e), and conventional civil survey techniques described in Section 4.19 of the SAP (IT, 1998e). Horizontal coordinates were referenced to the U.S. State Plane Coordinate System, Alabama East Zone (NAD, 1983). Elevations were referenced to the North American Vertical Datum of 1988 (NAVD88). Horizontal coordinates and elevations are included in Appendix J.

2.10 Investigation-Derived Waste Management

Management and disposal of the investigation-derived wastes (IDW) followed procedures and requirements as described in Appendix D of the SAP (IT, 1998e). The IDW generated at the Fill Areas included decontamination fluids and disposable personal protective equipment. The IDW was staged in the fenced area surrounding Buildings 335 and 336 while awaiting final disposal.

Investigation-derived waste (IDW) from SI and EE/CA field activities was managed and disposed as outlined in Appendix D of the SAP (IT, 1998e). The IDW generated during the EE/CA Field activities for Parcels 78(6), 79(6), 80(6), 230(7), 227(7), 126(7), 229(7), 231(7), and 82(7) was segregated as follows:

- Drill cuttings
- Soil from split spoon sample collection efforts
- PPE
- Decontamination fluids
- Development and purge water.

Solid IDW from the SIs was stored inside the fenced area surrounding Buildings 335 and 336 in lined rolloff bins prior to characterization and final disposal. Solid IDW was characterized using toxicity characteristic leaching procedure (TCLP) analyses. Based on the results, soil boring cuttings and personal protective equipment generated during the SIs were disposed of as a non-regulated waste at the Industrial Waste Landfill on the Main Post of FTMC.

Liquid IDW was contained in the existing 20,000-gallon sump associated with the Building T-338 vehicle washrack. Liquid IDW was characterized by VOC, SVOC, and metals analyses. Based on the analyses, liquid IDW was discharged as non-regulated waste to the FTMC wastewater treatment plant on the Main Post.

Soil and auger cuttings from EE/CA soil borings were placed back in the boreholes at the completion of sample collection at each location. PPE was stored in lined rolloff bins prior to final disposal. Used PPE generated during field activities was characterized using TCLP analysis. Based on the results, PPE generated during the fill area definition investigation were disposed as nonregulated waste at the Industrial Waste Landfill on the Main Post of FTMC.

3.0 Field Activities and Results for Landfill No. 1, Parcel 78(6)

3.1 Introduction

Landfill No. 1, Parcel 78(6) is one of several former waste disposal areas for wastes generated primarily by FTMC operations. This parcel is identified as a category 6 site in the environmental baseline survey (EBS) and, thus, is considered an area of known contamination where required response actions have not been taken (ESE, 1998). The original CERFA parcel boundary for Landfill No. 1 is shown in the detail and sample location map in Figure 3-1. Fill area definition activities were conducted at Landfill No. 1 to delineate the vertical and horizontal extent of waste fill at this parcel and to characterize the fill material. This section presents the results of those activities.

3.2 Site Description

Landfill No 1 is located in the western part of the Main Post of FTMC, as shown in Figure 1-2. The landfill was the FTMC sanitary landfill from 1945 to 1947. Aerial photographs taken in 1944 document the clearing for the landfill. The Landfill No.1 parcel boundary covers approximately 12 wooded acres on the side of a hill located between 16th Avenue and Avery Drive. Adjacent to the landfill site is the floodplain of an intermittent creek that discharges to a tributary of Remount Creek.

3.2.1 Site Geology

Soils underlying Landfill No. 1 are mapped as Montevallo Series (USDA, 1961). These soils are characterized as shaly silty clay loam. Montevallo Series soils are developed in the residuum of interbedded shale and fine-grained sandstone and limestone. Bedrock beneath the southern two thirds of this site is mapped as Mississippian/Ordovician Floyd and Athens shale, undifferentiated. As described in Section 1.4, these units occur within the eroded "window" in the uppermost structural thrust sheet at FTMC and underlie much of the developed area of the Main Post. The northern third of Landfill No. 1 is mapped as Cambrian Shady Dolomite. A geologic map of the area, including Landfill No. 1 is presented in Figure 1-3.

Based on boring and trench log data collected during fill area definition activities, soils beneath the fill material at Landfill No. 1 consist of yellow to olive green mottled clay with some traces of medium to coarse grained sand. Brown to black weathered shale was encountered at depths ranging from approximately 15 to 18 feet below ground surface (bgs). Boring logs for the four wells on site indicate weathered shale was encountered at depths ranging from approximately 7 to 12 feet (SAIC, 1995).

3.2.2 Site Hydrogeology

SAIC installed four groundwater monitoring wells (LF1-G01, LF1-G02, LF1-G03, and LF1-G04) at the site in 1994 (SAIC, 1995). IT measured the depth to groundwater in these wells on April 26, 2000 following procedures outlined in Section 4.7 of the SAP (IT, 1998e). Recorded depths to groundwater ranged from 0.2 to 30.8 feet bgs. A summary of the April 2000 groundwater levels is presented in Table 3-1. Groundwater elevation contours for Landfill No. 1 were developed from these groundwater level measurements and are presented in the potentiometric surface map (Figure 1-4). This figure shows that groundwater flow is to the southeast toward a tributary to Remount Creek and follows the general slope of the topography. The calculated average horizontal hydraulic gradient across the site is 0.04 foot per foot (ft/ft). Hydraulic conductivity measurements were obtained in LF1-G02 (3.27×10^{-4} cm/sec) and LF1-G03 (4.08×10^{-5} cm/sec) (SAIC, 2000).

3.2.3 Surface Hydrology

Surface runoff at Landfill No. 1 flows to the southeast to an intermittent tributary stream located northwest and southeast of 16th Avenue. The landfill is adjacent to the floodplain of the intermittent tributary stream that discharges into Remount Creek southeast of the site.

3.3 Previous Site Characterization

Landfill No. 1 was identified in the preliminary site assessment as an "Area Requiring Environmental Evaluation" (Weston, Roy F., Inc., 1990). A geophysical survey conducted in 1992 over approximately 2 acres of the site found geophysical anomalies that were attributable to surface debris, and not to large-scale land filling (SAIC, 1993).

The estimated boundaries of the landfill were revised in 1993 based on a review of historical aerial photographs conducted during a site (SAIC, 1993). Geophysical surveys were conducted in an attempt to delineate the boundary of the landfill (SAIC, 1993). During this investigation, a larger-scale geophysical survey was conducted using electromagnetic (EM) and magnetometer methods. An approximate landfill boundary for Landfill No. 1 was established based on the results of this survey. This boundary corresponds to the original CERFA Parcel 78(6) boundary.

SAIC collected groundwater samples from the 4 existing monitoring wells (LF1-G01, LF1-G02, LF1-G03, and LF1-G04) at Landfill No. 1 in June and July 1994 and in January and February

1995. Additionally, one monitoring well (LF1-G01) was sampled in October 1997. The results of these sampling events are fully documented in previous reports (SAIC, 1995 and 1999). The well/groundwater sample locations are shown in Figure 3-1. Table 3-2 summarizes the well construction details.

IT sampled three monitoring wells (LF1-G01, LF1-G02, and LF1-G03) in February 1998. LF1-G04 was omitted from the sampling event conducted in 1998 because it reportedly contained a broken well screen. The results are summarized in the Long-Term Monitoring Report – First Quarterly Report for Landfills 1, 2, and 3 (IT, 1998c). Groundwater samples were analyzed for VOCs, SVOCs, pesticides and polychlorinated biphenyls (PCBs), metals, and nitroexplosives. Metals, VOCs, and SVOCs were detected above reporting limits. The levels of metals were within the range of background concentrations for unfiltered groundwater at the FTMC Main Post, with the exception of barium. Reported VOCs and SVOCs were attributed to field or laboratory contamination. Reported VOCs (acetone, methylene chloride, and toluene) and one SVOC (di-n-butyl phthalate) were attributed to field or laboratory contamination (IT, 1998c). Acetone was detected at LF-G01 with a concentration of 14 μg/L. Methylene chloride was detected at LF-G01 and LF1-G02 with concentrations of 0.49 μg/L and 0.18 μg/L, respectively. Toluene was detected at LF1-G01, LF1-G02, and LF-G03 with concentrations of 0.22 μg/L, 0.18 μg/L, and 0.18 μg/L, respectively. Di-n-butyl phthalate was detected at LF-G01, LF1-G02, and LF-G03 with concentrations of 2.7 μg/L, 3.7 μg/L, and 12.0 μg/L, respectively. The methylene chloride, toluene, and two of the di-n-butyl phthalate results were flagged with a J qualifier, signifying the results were estimated values less than the laboratory reporting limit but greater than the method detection limit. The methylene chloride results were also flagged with a B data qualifier signifying the compound was also detected in the associated method blank.

3.4 Fill Area Definition Activities

IT conducted field activities from January through August 2000 for the delineation of the fill area at Landfill No. 1. These activities included a geophysical site survey, exploratory trenches, soil borings, and a visual site walk. Initial field activities consisted of clearing trees and brush to allow access for the geophysical survey crews to establish survey lines. Additional clearing was required prior to trenching and soil boring activities to allow the trackhoe and ATV drill rig access to the trench and soil boring locations. Eleven trenches were excavated to determine the horizontal and vertical extent of fill material and to determine the cause of geophysical anomalies identified in 1993 by SAIC. Three soil borings were drilled to determine the vertical extent of the fill material and collect samples for laboratory analysis. IT also conducted a site walk to search for leachate seeps along the toe of the landfill; however, none were observed.

Environmental sampling performed during these field activities included the collection of subsurface soil and fill material samples for laboratory analyses. Sample locations were determined using the methodology defined in Section 2.3. Sampling locations are shown in Figure 3-1. Samples were submitted for laboratory analyses of site-related parameters listed in Section 2.4.

3.4.1 Geophysical Survey

A geophysical survey was conducted at Landfill No. 1 by IT personnel in January 2000 to determine the boundaries of the fill area. A radial pattern of 14 lines was established at the site to encompass suspect landfill areas, as shown in the geophysical interpretation map (Figure 3-2). A total of 4,200 linear feet of geophysical survey were conducted at Landfill No. 1. A detailed discussion of the geophysical investigation, including theory of operation of the instruments, field procedures, data processing, and interpreted results of the investigation, is presented in Appendix A (Geophysical Survey Report).

A detailed, hand-sketched site map along each radial line was drawn in the field. The map included any surface cultural features within 20 feet of each survey line that could potentially affect the geophysical data (e.g., mounds and depressions, roads, and man-made changes in topography). Linear graphical representations of the data were analyzed and compared with the site sketch to differentiate between anomalies caused by surface and subsurface source materials. Linear EM anomalies potentially representing underground utilities were verified with an EM utility locator and their locations placed on the site map.

Geophysical survey line data was compared to site maps so that anomalies reflecting surface features would not be erroneously interpreted. Interpretation of the geophysical data was based on the deviation of the data from background. Interpretation of the magnetic and EM data determined the landfill boundary for each geophysical line, as shown in the geophysical site interpretation map in Figure 3-2.

A more detailed discussion of the data interpretation is included in the interpretation chapter of the geophysics report (Appendix A).

3.4.2 Trenching Activities

Eleven exploratory trenches were excavated to determine the fill area boundary and to characterize the fill material. Two additional exploratory trenches were excavated to determine the cause of isolated anomalies identified during the geophysical survey conducted by SAIC in 1992. Trenches were excavated to depths ranging from 4 to 10 feet bgs. A summary of the trenching information is provided in Table 3-3. Trenching procedures are described in Section 2.8. Trench logs are provided in Appendix I.

During trenching operations at T78-1 in Landfill No. 1, the onsite geologist identified what he thought to be a potential grenade within the trench excavation. The field crew notified the IT site manager and requested UXO support at the trench site to examine the item. Before the UXO technician was able to fully examine the item, the walls of the trench collapsed, burying the observed item and preventing positive identification. The item is currently buried approximately 8 feet below ground surface. Additional fill material associated with trench T78-1 included glass bottles, broken plates, scrap metal, and pieces of coal.

Trenches T78-5 and T78-10 contained medical waste as well as typical waste encountered in the other trenches including glass bottles and jars, metal food containers, and jar lids. Medical waste at trench T78-5 included three glass medical bottles with rubber septa. Trench T78-5 encountered gray green shale bedrock at 7 feet bgs. This was the only trench location where bedrock was encountered during trenching at Landfill No. 1. Medical waste associated at T78-10 consisted of a glass syringe (no needle) and three medical bottles.

Fill material associated with trenches T78-2, T78-3, T78-4, T78-6, T78-7, and T78-8 included glass bottles, coal, scrap metal, metal food containers, wood pieces, broken plates, melted glass, black to gray ash, newspaper, leather boots, brick, and pieces of steel cable. Trench T78-9 fill material included the previously mentioned fill materials, as well as a piece of sheet metal identified as the cause of the geophysical anomaly detected at this trench location. Trench T78-10 fill material included the previously mentioned fill materials, as well as coiled steel wire, and miscellaneous scrap metal pieces identified as the cause of the geophysical anomaly detected at this trench location. Trenches T78-11, T78-12, and T78-13 fill material mainly consisted of ash, wood, glass, and some metal fragments at depths ranging from 3 to 8 feet bgs.

Based on the results of the trenching activities, the estimated extent of waste fill at Landfill No. 1 was reduced from approximately 12 acres to 6.3 acres in size. The fill area boundary is shown in the fill area definition map for Landfill No. 1 (Figure 3-3).

3.4.3 Fill Material Sampling Borings

In March 2000, IT installed three direct-push soil borings at Landfill No.1 at the locations shown in Figure 3-1 to determine the vertical extent of the fill material. Soil borings were installed at depths ranging from 14.8 to 18 feet bgs. Subsurface soil/fill material samples were collected from each boring for chemical analysis to identify chemicals of potential concern in the fill material. A summary of fill material information is presented in Table 3-4. Field procedures are described in Section 2.7.

A total of four subsurface soil/fill material samples were collected and analyzed for the parameters listed in Section 2.4. Analytical results were compared to residential human health SSSLs, background screening values, and ESVs, as presented in Table 3-5 (Detected Compounds in Fill Material Samples). Sample collection logs and chain-of-custody records are presented in Appendix B.

Metals. A total of 21 metals were detected in the subsurface soil/fill material samples collected at Landfill No. 1.The concentrations of arsenic detected in the sample collected from location FA-78-SB01 and aluminum detected in the sample collected from location FA-78-SB03 exceeded the background screening values and the SSSLs. The concentrations of 12 metals (Aluminum, Arsenic, Beryllium, Boron, Cadmium, Cobalt, Iron, Lead, Manganese, Mercury, Nickel, and Vanadium) exceeded background screening values in various samples. No other metals exceeded background screening values or SSSLs.

Volatile Organic Compounds. Nineteen VOCs were detected in the subsurface/fill material samples collected at Landfill No. 1, with two VOCs (methylene chloride and trichlorofluoromethane) detected in all four samples collected; however, none of the detected VOC concentrations exceeded the SSSLs.

Semivolatile Organic Compounds. Six SVOCs were detected in the subsurface/fill material samples collected at Landfill No. 1. One SVOC (bis[2-ethylhexyl]phthalate) was detected in all four samples collected; however, none of the detected SVOC concentrations exceeded the SSSLs.

Pesticides. Three pesticides were detected in the subsurface soil/fill material samples collected at Landfill No. 1, with one pesticide (4,4,4'-DDE) detected in all four samples collected. None of the detected pesticide concentrations exceeded the SSSLs.

No herbicides, explosives, or PCBs were detected in the subsurface soil/fill material samples collected.

3.5 Extent of Fill Material

IT has estimated the vertical and horizontal extent of fill material at Landfill No. 1 based on information gathered from previous site investigations and trenching and boring activities discussed in this report. The fill area at Landfill No. 1 covers an area of approximately 6.3 acres, as shown in Figure 3-3. The average depth of fill material estimated from the trench and boring log data is approximately 11.5 feet bgs.

3.6 Variances/Nonconformances

There were no variances or nonconformances identified either in the field or during the review of the sample collection logs that may have impacted the usability of the data.

4.0 Field Activities and Results for Landfill No. 2, Parcel 79(6)

4.1 Introduction

Landfill No. 2, Parcel 79(6) is one of several former waste disposal areas for wastes generated primarily by FTMC operations. This parcel is identified as a category 6 site in the EBS and, thus, is considered an area of known contamination where required response actions have not been taken (ESE, 1998). The original CERFA parcel boundary for Landfill No. 2 is shown in Figure 4-1. Site investigation and fill area definition activities were conducted at Landfill No. 2 to delineate the vertical and horizontal extent of waste fill at this parcel and to characterize the fill material. This section presents the results of those activities.

4.2 Site Description

Landfill No. 2 is located in the central part of the Main Post of FTMC, as shown in Figure 1-2. The landfill was used as a sanitary landfill after the closure of Landfill No. 1, and was active from 1947 to an unknown date. The initial Landfill No. 2 study area (the original CERFA parcel plus additional fill area observed by IT) covered approximately 3.4 acres at the southern base of Cemetary Hill between 2nd Avenue and 10th Street. The southern boundary of the site is within the floodplain of Cave Creek, which flows to the south-southwest adjacent to the site (Figure 1-5). The general location of Landfill No. 2 is illustrated in Figure 4-1.

4.2.1 Site Geology

Soils underlying Landfill No. 2 are mapped as Montevallo Series (USDA, 1961). These soils are characterized as shaly silty clay loam. Montevallo Series soils are developed in the residuum of interbedded shale and fine-grained sandstone and limestone.

Bedrock beneath this site is mapped as Mississippian/Ordovician Floyd and Athens Shale, undifferentiated. These units occur within the eroded "window" in the uppermost structural thrust sheet at FTMC and underlie much of the developed area of the Main Post. A geologic map of the area, including Landfill No. 2 is presented in Figure 1-3.

Based on boring and trench log data collected during fill area definition activities, soils beneath the fill material at Landfill No. 2 consist of yellow to gray clay with some traces of mottled sand. This clay was encountered at a depth of approximately 12 feet bgs in soil boring location FA-79-SB01.

4.2.2 Site Hydrogeology

SAIC installed three groundwater wells (LF2-G01, LF2-G02, and LF2-G03) at Landfill No. 2 during the site investigation (SAIC 1993). IT measured the depth to groundwater in these wells on March 13, 2000 following procedures outlined in Section 4.7 of the SAP (IT, 1998e). Recorded depths to groundwater ranged from 7 to 25 feet bgs. A summary of the March 2000 groundwater levels is presented in Table 4-1. Groundwater elevation contours for Landfill No. 2 were developed from these groundwater level measurements and are presented in the potentiometric surface map (Figure 1-4). This figure shows a southwesterly groundwater flow direction following the Cave Creek drainage. Based on the March 2000 water levels, the calculated average horizontal hydraulic gradient across the site ranged from 0.01 to 0.001 ft/ft. A hydraulic conductivity measurement was obtained in LF2-G02 (2.89×10^{-5} cm/sec) (SAIC, 2000).

4.2.3 Surface Hydrology

Surface runoff at Landfill No. 2 flows to the southwest toward Cave Creek. The landfill is located within the floodplain of the creek (Figure 1-5).

4.3 Previous Site Characterization

Landfill No. 2 was identified in the preliminary site assessment as an "Area Requiring Environmental Evaluation" (Weston, Roy F., Inc., 1990, for USATHAMA). The site area has been identified as the former location of an incinerator that was operated as early as 1927. A crescent-shaped "refuse dump" was also identified on a 1937 map of the Main Post of the FTMC (ESE, 1998). The landfill reportedly was used to dispose of unspecified "waste" during deactivation of the installation (USAEHA, 1986). Rusted drums, metal, small containers (5-gallon cans and bottles), assorted building materials, and machinery parts were observed at the site in October 1991. Demolition debris (asphalt, concrete, and glass) were exposed at the landfill by road-building operations during the site investigation in 1992 (SAIC, 1993).

SAIC acquired reconnaissance geophysical profile data from March 1994 to February 1995 over approximately 3.5 acres of the site and found geophysical anomalies attributable to buried metal (SAIC, 1995).

SAIC sampled the three existing monitoring wells (LF2-G01, LF2-G02, and LF2-G03) at Landfill No. 2 in June 1992, July 1994, January 1995, and October 1997. The results of these sampling events were summarized in previously published reports (SAIC, 1993, 1995, 1999).

Well construction details are provided in Table 4-2. Additional groundwater sampling was conducted by IT personnel in February 1998 to determine if groundwater quality had been impacted from historical landfilling practices. The results were previously summarized in the Long-Term Monitoring Report – First Quarterly Report for Landfills 1, 2, and 3 (IT, 1998g). Groundwater samples were analyzed for VOCs, SVOCs, pesticides, PCBs, metals, and nitroexplosives. The analytical data indicated that all detected compounds were present in trace concentrations, within site background values, and at levels below risk-based concentrations (IT, 1998g).

IT conducted an SI to identify COPCs in surface soil, characterize the source of COPCs, determine the nature and extent of COPCs, and support the evaluation of the level of risk to human health and the environment posed by potential releases of the COPCs. The SI included field work to collect five surface soil samples at Landfill No. 2. This section summarizes SI activities including the geophysical survey, environmental sampling, and analysis.

4.3.1 Geophysical Survey

A geophysical survey was conducted at Landfill No. 2 by IT personnel in January and February 2000 to determine the boundary of the fill area and to identify anomalies within the fill area that would require further characterization. A base grid on 100-foot centers was established for the site, with line spacing of 20 feet, and control points marked on 10-foot centers to provide spatial control required for the investigation. Further detail on the site geophysical survey lines is provided in the Geophysical Survey Report for Landfill No. 2 (Appendix A). The total area surveyed was approximately 497,800 square feet (11.4 acres).

A detailed discussion of the recent geophysical investigation of Landfill No. 2, including theory of operation of the instruments, field procedures, data processing, and interpreted results of the investigation is presented in Appendix A. The survey was conducted in accordance with the Fill Area Definition Work Plan (IT, 2000a) and Section 2.2.

The geophysical survey results indicate several anomalies at Landfill No. 2. These anomalies are caused by large-scale disposal areas, landfill pits, anomalous high conductivity areas, isolated buried metal objects, and areas of surface metal debris. The geophysical interpretation map (Figure 4-2) shows the anomaly locations and contains detailed information on permanent site reference features as well as civil survey coordinates to aid in relocating the anomalies and the survey area. The anomalies shown in the interpretation maps correspond to those illustrated in the magnetic and EM linear data displays presented in the geophysics report (Appendix A).

4.3.2 Environmental Sampling

The environmental sampling performed during the SI included the collection of surface soil samples for chemical analysis. Sample collection techniques are described in Section 2.3. Sample collection logs and chain-of-custody records are provided in Appendix B. Analytical results were compared to background screening values, residential human health SSSLs, and ESVs.

4.3.2.1 Surface Soil Sampling

Surface soil samples were collected from five locations at Landfill No. 2. Sampling locations are illustrated in Figure 4-1. Surface samples were collected from the upper 1-foot of soil. Analytical results are presented in Table 4-3.

Metals. Twenty-three metals were detected in the surface soil samples collected. The concentrations of aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, thallium, vanadium, and zinc exceeded the background screening values and ESVs in most samples. Antimony, barium, chromium, copper, lead, manganese, and thallium were detected at concentrations that exceeded the SSSLs in most of the surface soil samples. Concentrations of aluminum, arsenic, and iron exceeded the SSSLs in all surface soil samples. All surface soil samples collected had concentrations of aluminum, chromium, iron, lead, manganese, vanadium, and zinc that exceeded the ESVs.

Volatile Organic Compounds. Six VOCs were detected in surface soil samples collected from three locations. None of the detected VOC concentrations exceeded the SSSLs or ESVs.

Semivolatile Organic Compounds. Fifteen SVOCs were detected in the surface soil sample collected from location FA-79-SS01. Benzo(a)anthracene and benzo(a)pyrene were detected at concentrations that exceeded both the SSSLs and the ESVs. Benzo(a)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene exceeded the SSSLs. Five other SVOCs detected (anthracene, chrysene, fluoranthene, phenanthrene, and pyrene) were present at concentrations exceeding the ESVs. No other surface soil samples collected contained detectable concentrations of SVOCs.

No pesticides or PCBs were detected in the surface soil samples collected.

4.4 Fill Area Definition Activities

Field activities were conducted by IT personnel from January through March 2000, for the delineation of the fill area at Landfill No. 2. These activities included a geophysical site survey, exploratory trenches, one soil boring, and a site walk. Initial field activities consisted of clearing trees and brush to allow access for the geophysical survey crews to establish a survey grid and survey lines. Additional clearing was required prior to trenching and soil boring activities to allow the trackhoe and all-terrain vehicle (ATV) direct-push drill rig access to trench and soil boring locations. One soil boring was advanced to determine the vertical extent of the fill material and collect samples for laboratory analysis. A site walk was conducted by IT personnel to search for leachate seeps along the toe of the landfill; however, none were observed.

Environmental sampling performed during these field activities included the collection of subsurface soil and fill material samples for laboratory analyses. The site manager determined sample locations in accordance with the work plan and Section 2.3. Sampling locations are illustrated in Figure 4-1. Samples were submitted for laboratory analyses of the parameters listed in Section 2.4.

4.4.1 Trenching Activities

Trenches were excavated to determine the extent of waste fill at Landfill No. 2, and to characterize the fill material. Four additional exploratory trenches were excavated to determine the cause of anomalies identified during the geophysical survey conducted by SAIC in 1992. Trenches were excavated to depths ranging from 3 to 18 feet bgs. A summary of the trenching information is provided in Table 4-4. Trench logs are provided in Appendix I.

Trenches T79-9 and T79-10, which were located north of the initial delineation of the Landfill No. 2 area, both contained large quantities of metal at depths ranging from 0.2 feet to 2.5 feet bgs. This material included piping, sheet metal, cable, and miscellaneous metal pieces. Other fill material in these areas included ash, glass, and brick.

Items found in trench T79-7 include a 100-pound bomb steel casing and the additional fill material. The fill material described in trench T79-7 between the depths of 3 and 18 feet bgs included a metal pipe, burned wood, concrete, numerous scrap metal pieces, coal, ash, glass, and rounded chert cobbles. Approximately half of the glass detected in this trench was melted.

Fill material associated with trenches T79-1 through T79-11 typically included ash, brick, glass, melted glass, wood pieces, concrete, pieces of broken plates, and scrap metal. Trench T79-3 also contained a 55-gallon drum lid, rounded stones (4-inch to 10-inch diameter), and stone tile pieces. Wire and nails were also found in Trenches T79-4 and T79-5. Steel cable, tin roofing, and a large amount of twisted or bent steel were found in Trench T79-6.

Chert or sandstone cobbles and/or stones were found in several of the trenches (T79-2, T79-4A, T79-8, T79-10, and T79-11) and appear to be native materials.

Trench T79-8 contained only native sand, clay, and chert and sandstone cobbles. No fill material was encountered in this trench.

The presence of ash and construction-type materials detected in many of the excavated trenches is consistent with the historical usage of the site as both an incinerator location and, later, as a construction-debris landfill.

Based on the results of the trenching activities, the estimated extent of fill material at Landfill No. 2 was increased from approximately 3.4 acres to 5.6 acres. The interpreted fill area boundary is shown in the fill area definition map for Landfill No. 2 (Figure 4-3).

4.4.2 Fill Material Borings

One soil boring (FA-79-SB01) was advanced in the middle of Landfill No. 2, as shown in Figure 4-1, to determine the vertical extent of the fill material. The termination depth of the boring was 14 feet bgs. A summary of fill material information is provided in Table 4-5.

One sample of the fill material was collected from the boring and submitted for chemical analysis. The sample was tested for the parameters listed in Section 2.4. Sample collection logs and chain-of-custody records are provided in Appendix B. Analytical results were compared to the residential human health SSSLs, and ESVs, as presented in Table 4-6.

Metals. Twenty-two metals were detected in the subsurface soil sample collected. Sixteen of these metals had detectable concentrations exceeding background screening values. A total of ten metals (aluminum, antimony, arsenic, barium, chromium, iron, lead, manganese, thallium, and zinc) exceeded the SSSLs. Of these, seven metals (antimony, arsenic, barium, chromium, iron, lead, and zinc) exceeded both the background screening values and the SSSLs.

Volatile Organic Compounds. Five VOCs were detected in the subsurface soil sample collected; however, none of the detected VOC concentrations exceeded the SSSLs.

Semivolatile Organic Compounds. Ten SVOCs were detected in the subsurface soil sample collected; however, none of the detected SVOC concentrations exceeded the SSSLs.

Pesticides. One pesticide was detected in the soil boring sample collected; however, the concentration did not exceed the SSSL .

No herbicides, explosives, or PCBs were detected in the fill material sample collected.

4.5 Extent of Fill Material

IT has estimated the vertical and horizontal extent of fill material at Landfill No. 2 based on information gathered from previous site investigations and trenching and boring activities discussed in this report. The fill area at Landfill No. 2 covers an area of approximately 5.6 acres, as shown in Figure 4-3. The average depth of fill material estimated from the trench and boring log data is approximately 8 feet bgs.

4.6 Variances/Nonconformances

One variance, expansion of the geophysical survey grid, was made to the site-specific field sampling plan (SFSP). As summarized in Table 4-7, this change was made to allow additional data collection for delineation of the fill area at Landfill No. 2. Variance reports are included in Appendix K.

5.0 Field Activities and Results for Landfill No. 3, Parcel 80(6)

5.1 Introduction

Landfill No. 3, Parcel 80(6) is one of several former waste disposal areas for wastes generated primarily by FTMC operations. This parcel is identified as a category 6 site in the EBS and, thus, is considered an area of known contamination where required response actions have not been taken (ESE, 1998). The original CERFA parcel boundary for Landfill No. 3 is shown in Figure 5-1. Fill area definition activities were conducted at Landfill No. 3 to delineate the vertical and horizontal extent of waste fill at this parcel and to characterize the fill material. This section presents the results of those activities.

5.2 Site Description

Landfill No. 3 is located in the northwest corner of the Main Post (Figure 1-2). The landfill is bounded by woods near the Anniston-Jacksonville Highway (Route 21) to the west and 4th Avenue to the east. The original CERFA parcel boundary for Landfill No. 3 included approximately 21 acres. This site was the Main Post sanitary landfill from 1946 to 1967 (ESE, 1998). The northern, eastern, and western boundaries are well defined (i.e., terminus of trench depressions, drainage swales, and roads). Delineation of the southern boundary was the focus of the fill area definition investigation at this site. The southern portion of the site is within the floodplain of Cave Creek, which flows to the west adjacent to the site (Figure 1-5).

The landfill was constructed using trenches that extend east-west across the site from 3rd Avenue. The waste was placed in the trenches and subsequently covered with topsoil (Weston, Roy F., 1990). The depth of the trenches has not been determined (SAIC, 1993). A complete manifest of all wastes deposited at the landfill is not available; however, it has been reported that empty pesticide containers, and the burned ammunition pallets or crates were disposed in this landfill (ESE, 1998). The pesticide containers were reported to have been triple-rinsed prior to disposal. Additionally, there is the potential for disposal of paint containers, fluorescent bulbs and ballasts, waste oil, and construction debris at this site (ESE, 1998). The landfill was not capped when it was closed in 1967, and settling is occurring. Forty-nine trench depressions can be observed, oriented east to west.

5.2.1 Site Geology

Soils underlying Landfill No. 3 are mapped as Cumberland gravelly loam, 2 percent to 6 percent slopes, eroded type soil (CoB2) (USDA, 1961). The thickness of the alluvium ranges from 2 feet to 15 feet or more, and in some areas overlie beds of gravel or sand. These soils have developed in old general alluvium that washed from soils derived mainly from limestone and cherty limestone, and to some extent, shale and sandstone. Rounded chert, sandstone, and quartzite gravel, as large as 3 inches in diameter, are on and in the soil.

Bedrock beneath Landfill No. 3 is mapped as the Cambrian Rome Formation on the western portion of the site, and Cambrian Conasauga formation on the eastern portion of the site. The Rome Formation consists of grayish-red-purple mudstone, shale, siltstone, and greenish-red and light gray sandstone, with locally occurring limestone and dolomite. The Conasauga Formation is composed of dark-gray, finely to coarsely crystalline medium to thick-bedded dolomite with minor shale and chert (Osborne et al., 1989). A geologic map of the area, including Landfill No. 3 is presented in Figure 1-3.

5.2.2 Site Hydrogeology

During boring and well installation activities, groundwater was generally encountered in clayey sand zones at depths ranging from 17 feet to 72 feet bgs.

Static groundwater elevations were measured in seventeen site wells on March 14, 2000, as shown in Table 5-1. Depth to groundwater ranged from 17 to 73 feet below top of casing. The March 2000 measurements were used to construct the potentiometric surface map in Figure 1-4. Groundwater flow is to the west and northwest toward Anniston Jacksonville Highway with an average horizontal hydraulic gradient of approximately 0.02 to 0.04 ft/ft. The average hydraulic conductivity in five wells tested by SAIC was 4.61×10^{-5} centimeters per second (SAIC, 2000).

5.2.3 Surface Hydrology

The landfill surface slopes gently to the north and east. Surface runoff drains to the north along the west and east sides of the landfill converging at the northeast corner of the site.

5.3 Previous Site Characterization

The U.S. Army Environmental Hygiene Agency installed five groundwater monitoring wells in 1986. SAIC installed 13 additional monitoring wells during the site investigation and remedial investigation conducted from 1992 through 1995 (SAIC, 1993 and 1995). A review of the boring logs indicates that none of the borings for these wells penetrated fill material and all appear to be outside the fill material boundary. Well construction details are provided in Table 5-2. Currently, 18 groundwater monitoring wells are near this site. The majority of the wells were installed on the west side of the landfill, which is considered to be hydraulically downgradient. Three of these wells were placed outside of the parcel boundary, in the median of Alabama State Route 21, to assess the extent of groundwater contamination leaving the post.

A long-term groundwater sampling and analysis event at Landfill No. 3 was performed by IT in 1998. Groundwater samples from 18 wells were collected during this sampling event. Detected constituent concentrations were compared to the SSSLs, ESVs, and background screening values for FTMC. Thirteen VOCs were detected in groundwater at Landfill No. 3, including benzene, 1,1,2,2-tetrachloroethane (PCA), 1,1,2-trichloroethane (TCA), 1,1-DCA, 1,2-DCE, acetone, carbon disulfide, chlorobenzene, methylene chloride, PCE, TCE, toluene, and total xylenes. However, only six VOCs exceeded the SSSL values, including 1,1,2,2-PCA (OLF-G07 and OLF-G12), 1,1,2-TCA (OLF-G07 and OLF-G12), 1,2-DCA (OLF-G12), acetone (OLF-G11), TCE (OLF-G07 and OLF-G12), and PCE (OLF-G12). On the basis of these results, VOCs are considered the primary COPCs at Landfill No. 3.

IT is conducting ongoing groundwater investigations at Landfill No. 3 to delineate the nature and extent of groundwater contaminants.

5.4 Fill Area Definition Activities

This section summarizes fill area definition activities conducted by IT at Landfill No. 3. These activities included trenching, soil borings, and fill material sampling and analysis. IT collected fill samples in March 2000 at this site to determine the horizontal and vertical extent of the fill area along the southern boundary of the parcel and to characterize the fill material.

5.4.1 Trenching Activities

Five exploratory trenches were excavated at Landfill No. 3 to characterize the horizontal and vertical extent of the fill material. Trenches were excavated to depths ranging from 5 to 15 feet bgs. Trench locations are shown in Figure 5-1. Trench locations T80-1 and T80-2 were used to further characterize the fill material at those locations. Trench locations T80-3, T80-4, and T80-5 were placed to further characterize the southern horizontal extent of the fill area. Trench logs are included in Appendix I and trenching information is summarized in Table 5-3. Trenching procedures are described in Section 2.8.

Fill material was observed in all the trenches and included: plastic sheeting, glass, wood, paper, metal cans, electrical wire, bricks, shaving cream bottles/cans, scrap metal, cloth, 55-gallon drum lids, beer cans/bottles, ash, tin cans, aluminum foil, newspaper, two metal chairs, cardboard, aerosol cans, concrete, medical bottle with septum, light bulbs, bones, shoes, metal bucket, steel rebar, building tiles, cinder blocks, and concrete bollards shaped like bombs.

Based on the results of the exploratory trenching at Landfill No. 3, the southern horizontal extent of the waste fill has been redefined, as shown in Figure 5-2. The approximate area within the new fill area boundary is 22.8 acres. The maximum depth reached was 15 feet bgs in trench T80-3. None of the trench excavations reached native material.

5.4.2 Fill Material Borings

Five fill material borings were drilled to investigate the depth of the waste and to characterize the fill material. Fill material borings were installed at depths ranging from 14 to 24 feet bgs. A summary of boring information is provided in Table 5-4. Five fill material soil boring samples were collected for chemical analysis at Landfill No. 3 to identify chemicals of potential concern. Sample locations are shown in Figure 5-1. The samples were analyzed for the parameters listed in Section 2.4. Sample collection logs and chain-of-custody records are provided in Appendix B. Analytical results were compared to the residential human health SSSLs, background screening values, and ESVs, as presented in Table 5-5.

Metals. Twenty-two metals were detected in the fill material samples collected. The concentration of thallium in the sample collected from location FA-80-SB04 exceeded the background screening value and the SSSL; however, the result was flagged with a "B" data qualifier signifying that the compound was also in an associated laboratory or field blank at a concentration greater than the reporting limit. Fill material boring samples collected had detected concentrations of aluminum, arsenic, and iron exceeding the SSSLs; however, none of the reported concentrations exceeded the background screening values. All the fill material samples collected had detectable concentrations of calcium and zinc exceeding background screening values. Four of the fill material samples collected had detectable concentrations of mercury exceeding the background screening values.

Volatile Organic Compounds. Twenty-one VOCs were detected in the fill material soil boring samples collected; however, none of the VOCs detected exceeded the SSSLs.

Semivolatile Organic Compounds. Sixteen SVOCs were detected in the fill material samples collected; however, none of the detected concentrations exceeded the SSSLs.

Pesticides. Twelve pesticides were detected in the fill material samples collected. None of the detected pesticides were present at a concentration exceeding the SSSLs.

PCBs. One PCB was detected in three of the fill material samples collected. Aroclor 1242 was detected in the fill material samples collected from locations FA-80-SB01, FA-80-SB02, and FA-80-SB04. The sample collected from location FA-80-SB01 had a detectable concentration of Aroclor 1242 that exceeded the ESV.

No herbicides or explosives were detected in the fill material samples collected.

5.5 Extent of Fill Material
IT has estimated the vertical and horizontal extent of fill material at Landfill No. 3 based on information gathered from previous site investigations and trenching and boring activities discussed in this report. The fill area at Landfill No. 3 covers an area of approximately 22.8 acres, as shown in Figure 5-2. The average depth of fill material estimated from the trench and boring log data is approximately 17 feet bgs.

5.6 Variances
No variances were recorded during the completion of the fill area definition investigation at Landfill No. 3.

6.0 Field Activities and Results for Landfill No. 4, Parcel 81(5) and Industrial Landfill, Parcel 175(5)

6.1 Introduction

Landfill No. 4, Parcel 81(5), is located in the northern portion of the Main Post (Figure 1-2). The landfill covers approximately 59.2 acres, 16 of which are permitted as the Industrial Landfill, Parcel 175(5) (Figure 6-1). The southern portion of the site is within the floodplain of Cave Creek, which flows to the west adjacent to the site (Figure 1-5).

6.2 Site History

Landfill No. 4, Parcel 81(5), was opened in 1967 as the Main Post Sanitary Landfill. This landfill was unlined and used trench and fill as the method of disposal. All of the Main Post household garbage, construction and demolition debris, oil-contaminated soil, and dead animals used in the U.S. Army Chemical School demonstrations were disposed in the Main Post Sanitary Landfill. One pound of waste Diazinon dust (pesticide) was reportedly disposed of here (ESE, 1998).

The landfill was closed in April 1994 because of a change in the permit requirements governing sanitary landfills. FTMC determined that it would be less expensive to take the sanitary trash offpost to the Calhoun County transfer station than to upgrade the landfill. The closed Main Post Sanitary Landfill (Landfill No. 4, Parcel 81[5]) was capped with clay.

The active Industrial Landfill, Parcel 175(5), is located on approximately 16 acres of Landfill No. 4 that was not previously used (Figure 6-1). FTMC received a temporary permit in 1993 to dispose of industrial and construction debris at this location. An application was then filed for a permanent Industrial Landfill permit to dispose of waste on top of the filled trenches. Alabama Department of Environmental Management (ADEM) advised FTMC to apply for a 30-ton/day-limit permit and use a previously unused section of the landfill property. This permit was issued in October 1995. The Industrial Landfill, Parcel 175(5) accepts industrial wastes including construction/demolition waste and/or rubbish. Construction debris includes, but is not limited to masonry materials, sheet rock, roofing waste, insulation, rebar, scrap metal, paving materials, and wood products. In addition, there is a designated area for asbestos disposal (ESE, 1998). Sludges from the oil/water separators from the Main Post that do not have separate National Pollutant Discharge Elimination System permits are spread in one area of this landfill. This type sludge is classified as a "special waste" and is covered under the Industrial Landfill permit number 08-02R (ESE, 1998). Groundwater at the landfill is monitored on a semiannual basis.

Appendix L contains the current permit for Parcels 175(5) and 81(5). The Industrial Landfill allows disposal of up to 1,200 tons per day of construction debris.

6.2.1 Site Geology

Four soils (Cumberland loam, Purdy silt loam, Tyler silt loam, and the Anniston gravelly loam) are mapped in the area of Landfill No. 4 and the Industrial Landfill. These soils are generally developed in the old alluvium that washed from soils derived mainly from limestone, shale, and sandstone. The color of these soils are generally brown to dark brown with lesser amounts of reddish-brown, grayish-brown, and yellowish-brown. Infiltration and permeability of these soil types range from very low to high (USDA, 1961). Reported geotechnical soil properties measured in the subsurface soils at the site show a range in hydraulic conductivity (K) from 3.9×10^{-8} to 4.3×10^{-7} cm/sec (USAEHA, 1976).

The bedrock mapped beneath Landfill No. 4 and the Industrial Landfill is the Cambrian Conasauga Formation. The Conasauga Formation is composed of dark-gray, finely to coarsely crystalline medium- to thick-bedded dolomite with minor shale and chert (Osborne et al., 1989). A geologic map of the area, including Landfill No. 4 and the Industrial Landfill, is presented in Figure 1-3.

6.2.2 Site Hydrogeology

Static groundwater levels were measured in the five site wells on March 14, 2000 and shown in Table 6-1. Depth to water ranged from approximately 8 to 28 feet below top of casing. The March 2000 measurements were used to construct the potentiometric surface map in Figure 1-4. Groundwater flow in the area of Landfill No. 4 converges from the north, south, and east; however, the general flow direction is east to west across the site. The calculated average horizontal hydraulic gradient across the site is approximately 0.01 to 0.02 ft/ft.

6.2.3 Surface Hydrology

Landfill No. 4 and the Industrial Landfill are relatively flat. The southern portion of the site is within the floodplain of Cave Creek. A floodplain map is illustrated on Figure 1-5. The current landfill rises above the surrounding grade by approximately 10 to 15 feet. A majority of the surface water collects in two surface drainage features, one in the eastern portion and the other along the southern boundary of Landfill No. 3. Surface water flows to the east in these two surface drainage features. Along the eastern boundary the surface drainage feature changes direction and flows to the north. The surface water from Landfill No. 4 eventually empties into Cave Creek.

6.3 Previous Site Characterization

Groundwater monitoring began at this landfill in 1978. Currently groundwater at the landfill is monitored on a semiannual basis. In addition, explosive gas levels are monitored annually (FTMC, 1995).

There are five existing monitoring wells at Landfill No. 4 and the Industrial Landfill (Figure 6-1). Additional monitoring wells have existed in the past at Landfill No. 4; however, the monitoring wells were removed prior to capping the landfill. Soil boring and monitoring well records for the former site wells are not available. A review of the boring logs from existing monitoring well locations LF4-MW1, LF4-MW2, LF4-MW3, LF4-MW4, and LF4-MW5 indicated that none of these borings penetrated the fill material. Appendix C contains the boring logs.

6.4 Fill Area Definition Activities

The extent of the fill material at Landfill No. 4 is defined by the existing surface expression and soil cover. The Industrial Landfill is a permitted, operating facility and the extent of fill at this parcel also is visually obvious. No further fill material investigation activities were conducted by IT.

6.5 Extent of Fill Material

Based on the extent of the existing cover, the combined area of Landfill No. 4, Parcel 81(5) and the Industrial Landfill, Parcel 175(5) is 59.2 acres.